## MESOZOTC INSECTS OF QUEENNLAND.

No.5. Mecoptera, the new Order Paratrichoptera, and abditions to Planipenvia.

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(Text-figs. 23-28).
The fossils dealt with in this Part belong to the third collection of fossil Insects from the Upper Trias of Ipswich, Queensland, already referred to in No. 3 of this series ( 4, p.417). In No. 1 of this series (3) I dealt with the Planipemnia, Trichoptera, and Protomecoptera from the second collection made by Mr. Dunstan (if we count in also the Simmonds collection, this would he the third collection made at Ipswich altogether). As the new insects throw much light upon the important Orders which they represent, it seemed best to deal with them as soon as possible, even though many other fossils from the earlier collections still remain undeseribed.

The material dealt with consists of two Mecoptera, two Tri-chopterous-like insects, one Planipennian, and one wing of uncertain position within the Panorpoid Orders. The Mecoptera are not well preserved, and one is too fragmentary to merit a name. The Planipennian, though not a complete wing, is one of the most beautifully preserved and most important of the new types found at Ipswich. One of the Trichopterous-like fossils is an almost complete and very heautifully preserved forewing, showing some quite new and unexpected characters, which prove that the wings from the $I_{p}$ swich Jrias which we have hitherto regarded as true Trichoptera, do not really belong to that Order, but to a distinct group separated from it by two rery important characters. My original intention was to place these within a
new Suborder Paratrichoptera of the Order Trichoptera. But this has been found to be quite ineompatible with more recent evidence fortheoming from a fine new fossil wing found in the Upper Coal Measures of Newcastle, which I shall shortly deal with in a separate paper. It is therefore necessary, in this paper, to propose the recognition of a new Order Paratrichoptera for the four genera of Trichopterous-like wings so far found at Tpswich, and to explain carefully the essential differences bet ween the two types of renation found in the Trichoptera on the one hand and the new Order on the other.

## Order MECOPTERA.

## Family S'IEREOCHORISTID A, fam.nov.

Small Scorpion-flies having the radial sector four-branched, the media six-branched. Cubital fork placed elose to base; $\mathrm{Cu}_{1}$ united to M by an oblique rein, the posterior arculus ( $p a$ ), which appears to be itself a true branch of $M$; the rein formed by the union of $p a$ with $\mathrm{Cu}_{1}$ continues as a straight, strong, convex vein for some distance, and then stops suddenly short, dividing into two weak and widely divergent branches, one joining up with $\mathrm{I}_{4}$ above, and the other with $\mathrm{Cu}_{2}+1 \mathrm{~A}$ below. $\mathrm{Cu}_{2}$ fuses with I A not far from its origin.

Originally I placed the genus Mesochorista in the family Panorpide. But its affinities are very great with the recent genus Trmiochorista from Brisbane; and this genus, in its turn, is allierl to the better known genus Chorista. These genera, distinguished amongst other characters by the five- or six-brancherd media of the forewings and the primitive form of the abdomen in the male, most certainly deserve to be separated out from the Punorpidre as a separate family, Choristide. I therefore now propose to adopt this family, and to place the Triassic fossil Mesochorista in it, together with the two recent genera Chorista and Treniohorista. The affinities of the Permian Permochorista with the Choristide are so close that it may also be adrisable to reduce the Permochoristidee to the status of a subfamily of the same family.

Gemus Stereochorista, n.g. (Text-fig. 23).
Characters of the family, with the following additions:Forkings of Rs and MI placed close together, at a level about two-fifths from base of wing. Apical forkings of the hranches of Rs placed more than usually far distad. An oblique crossvein comecting Rs with M at a level just before that of the origin of the posterior arculns. Branches of II intimately connected by three cross-veins, which form three well-defined closed cells distal from the median fork. 1A apparently threebrancherl.

Genotype, Stereochorista frustrata, n.sp. (Ulper Triassic, Ipswich, Q.).

This genus would appear to be allied to Mesochorista (2, p.29) from the same horizon; but the remarkable characters of the presence of a true posterior arculus and the shortened $\mathrm{Cu}_{1}$ are absolutely unique, and appear to warrant the formation of a new family for its reception I do not know of any other Mecopteron in which the posterior arculus can be definitely picked out: either it is reduced to a transverse vein, not distinguishable from a cross-vein, or else it is entirely obliterated by reason of the complete fusion of $\mathrm{Cu}_{1}$ with the main stem of MI for a short distance. In this connection, it should be noted that, within the single family Rhyacophitider in the Order Trichoptera, species can be found showing all three conditions. Undoubtedly the most archaic condition is that exhibited by Stereochorista, in common with such species as Agapetus fuscipes Curtis (fam. Rhyacophilidee) and with the majority of the Micropleryyide, viz, the presence of a true posterior arculus in the form of an oblique vein connecting the main stem of M with $\mathrm{Cu}_{1}$, not far distad from its origin at the cubital fork. The condition in Stereochorista strongly suggests that the vein usually called $\mathrm{Cu}_{1}$, distad from $p a$, is in reality a fused vein consisting of $\mathrm{Cu}_{1}$ and a posterior branch of M , which we may call $\mathrm{M}_{5}$, and of which $p^{\prime \prime}$ ( is the basal free piece. If so, then the name posterior arculus, due to Comstock, is a misnomer, and should be altered either to anterior arculus (this being the part of the Otionate arculus formed from M1 or simply to arculus.

Further evidence on this interesting point may be found on p. 207 of this paper.

## Sterlochorista frustrata, 11.sp. (Text-fig.23).

Total length 7.5 mm ., this being almost the full length of the wing (a little of the base missing). (irentest width of preserved portion, 2.3 mm ., representing an actual greatest width of the complete wing of about 3 mm . The impression of the wing is faint but good; there can be no doubt of the correctness of the condition of $\mathrm{Cu}_{1}$ as drawn, but the tracing of the closely arranged branches of $M$ is not an easy matter. $\mathrm{Cu}_{1}$ can be followed quite


Text-fig. 23.
Nteiforhoristu firmstrata, n.g. et sp., forewing. Upper Trias of Ipswich, Q. $p^{m}$, posterior arculus. Rest of lettering as usnal in ComstockNeedlham notation; $(\times 1 \underline{2})$.
clearly as a strong vein for some distance, when it suddenly ends quite definitely, sending very weak and widely diverging branches (possibly cross-veins) to $\mathrm{M}_{4}$ above and $\mathrm{Cu}_{2}+1 \mathrm{~A}$ below. A careful examination of these two veins shows us that $\|_{4}$, and $\mathrm{C}^{\mathrm{C}} \mathrm{u}_{2}+1 \mathrm{~A}$ are definitely tending to converge, so that there is not a sufficiently wide space left between them distally for $\mathrm{C}_{\mathrm{C}}$, to be continued; this may possibly accome for the peculiar mamer in which it ends. I have carefully examined the whole of the wing in this region, and can find no evidence of any break or damage; the condition of ' $\mathrm{i}, 1$ is evidently a natural one, thongh certainly most unusnal.

The preserved wing was almost certainly the forewing of a highly reduced type, which may very possibly have closely resembled the recent Nunnochoristidee in appearance.

Type, Specimen No. 218 (Coll. Queensland Geological Survey).
Horizon: Upper Triassic, Ipswich, Q.
Mecopteron incerte sedis. (Text-fig.24).
Specimen Nu 168a, b, consists of two fragments of a small Mecopterous wing, fairly well preserved, but not sufficiently complete to merit a name. Text-fig. 24 shows the venation of these fragments. In the larger there are four forked veins, the third and fourth being separated by a simple vein, while the fourth is also followed by another simple vein. Hence it may be suggested that the wing belongs to the C'horistide, the first


Text-fig. 24.
Two fragments $(a, b)$ of Mecopterous wings from Upper Trias of Ipswich, Q.; Specimen No. 168 $a, b ;(\times 13)$.
two forked veins representing the branches of Rs (with $\mathrm{R}, \mathrm{Sc}$, and the costal border indicated above them in order): while the third and fourth forked veins, together with the simple vein between them, and the simple vein posterior to the fourth, represent the six branches of the media. The positions of these veins, and their angles of divergence from one another, agree closely with those of other Choristide, but the relative positions of the
dichotomous branchings are quite different from those of any known form.

## Panorpoid Insect incerte Sedis.

Specimen No.114b is a badly-preserved wing which appears to belong to one of the Panorpoid Orders, but which cannot be determined with certainty. Parts of $\mathrm{Sc}, \mathrm{R}, \mathrm{M}$, and $\mathrm{Cu}_{1}$ are visible. $R_{1}$ is forked distally, Rs dichotomously forked many times over, M apparently five branched, and $\mathrm{Cu}_{1}$ straight and unforked. Length of fragment, 9.5 mm .; greatest breadth, 3.5 mm . The costal space was moderately wide, and shows portions of an archedictyon; there are also some slight signs of the same kind of meshwork in other parts of the wing.

This insect may perhaps be related to the Protomecoptera; but is so poorly preserved that I do not propose to name it.

Order PARATRICHOPTERA, ordo nova.
Triassic insects with wings in which the renation is on the Trichopterous plan, but differing from the true Trichoptera in two rery important points, as follows:-
(1) The three anal veins remain quite separate in the forewing. (In all true Trichoptera these three veins are looped up together in a very typical manner).
(2) $\mathrm{Cu}_{1}$ is a strong, straight, convex vein, without any apical fork. (In all arehaic genera of the true Trichoptera, $\mathrm{Cu}_{1}$ is forked apically).

A separate costal vein may be present. Rs and M both fourbranched, as in archaic genera of recent Trichoptera; both the radial and median cells closed

The discovery of the almost complete and remarkably wellpreserved wing of Aristopsyche, 11.g., shows that I was in error, in No. 1 of this Series(3), in restoring the forewings of Mesopsyche and T'riassopsyche on the typical Trichopterous plan, as regards the looping-up of the anal veins. I may also have been wrong in determining the presence of the wing-spot (a difficult thing to be certain of, in any fussil) since neither of the two new genera here dealt with shows any signs of it.

The archaic condition of the anal veins, and the miforked Cu $u_{1}$, connect the new Order with the Mecoptera. It sfems likely also that the Paratrichoptera were closely allied to the Diptera, which also have an morked $\mathrm{Cu}_{1}$, though the anal veins have undergone a reduction due to narrowing of the base of the wing.

The four genera of Paratrichoptera now known from Ipswich may be provisionally included within a single family, Mesopsychidre, the characters of which were defined in No.l of this Series (3. p.180). The following key will distinguish them:-

[^0]Sc and $R$ very close together; pterostigmatic region very long and narrow
3.
(2)
$\left\{\begin{array}{c}\text { Sc and } \mathrm{R} \text { further apart; pterostigmatic region not so narrow, } \\ \text { less regularly shaped; third apical fork with a cross-vein. } \\ \ldots . . . . . . \text { Triassopsycue Tillyard. }\end{array}\right.$
(3) $\left\{\begin{array}{c}\text { Only two or three costal veinlets present; second apical fork } \\ \text { sublivided into thee cells by cross-veins..... Mesopsycue Tillyard. } \\ \text { Numerons costal veinlets present; first apical fork with two } \\ \text { cross-veins; second apical fork undivided ...... Netropsycue, n.g. }\end{array}\right.$

Genus Aristopsyche, n.g. (Text-fig.25).
Character's of forewing:-Large wing with broadly rounded apex and very regular scheme of venation; no excess cross-veins in distal part of wing. A short but distinct costal vein present, ending on costal margin at about one-fifth of the total winglength; reinlets are present both between this vein and the costal border, and also between Sc and the same border. Se and K both straight, fairly close together: pterostigmatic region moderately long and narrow, with one veinlet. Both the radial (discoidal) and median cells closed, with all four apical forks sessile upon them, though the third fork is only just so. $\mathrm{Cu}_{1}$ a very strong, convex vein slightly bent downwards distally; not forked, but giving off two very strong, oblique, pusterior branches to join the vein below, which is probably $\mathrm{Cu}_{2}$. $\mathrm{Cu}_{1}$ distinctly
joined to $M$ near base. Anal veins distinct and quite separated distally.

G enotype, Aristopsyche superbre, n.sp. (Upper Triassic, Ipswich, Q.).

This genus would appear to be fairly closely allied to both Mesopsyche and T'riassopsyche. The form of the radial cell resembles that of the latter genus very closely, while the form of the median cell, with its peeuliarity of having the medio-cubital cross-vein attached almost exactly to the origin of $\mathrm{M}_{4}$, resembles that of the former genus. In the peculiar form of $\mathrm{C}_{1}$ there is also a close resemblance to Triassopsyche; in this latter genus, only enough of the wing is preserved to show the more distal of the two descending hranch-veins, and the more distal part of $\mathrm{Cu}_{1}$ is somewhat zigzagged, through being braced by excess erossveins, not present in Aristopsyche.

It is much to be regretted that, perfect as this fossil is (with the exception of a single break across the anal reins), some cuts made by the knife in exposing it have, most unfortunately, partially destroyed the impression in the region where the cubital fork should oceur, so that it is not possible to determine with certainty the true course of the veins $\mathrm{Cu}_{1}$ and $\mathrm{C}_{n_{2}}$ at their origins.

That the wing is truly a forewing there can be little doubt, not only because the fourth apical fork is present, but also because of the distinctness of the impression, the evident strength of the veins, the well-formed costal area, and the general shape of the wing. The difference between the formations of the anal veins in this fossil and in the forewings of all true Trichoptera is very remarkable; and there seems to be no doubt that the anal areas of the forewings of the other three genera from Ipswich must closely resemble this also. For Triassopsyche is so close to Aristopsyche that we are bound to conclude a close similarity in the form of their anal veins, though these are not preserved in the former genus. Moreover, in Neuropsyche, n.g., which will be seen to be equally close 10 Mesopsyche, some of the anal area is preserved, and is found to be closely similar to that of Aristopsyche.

Aris'opsyche superba, n.sp. (Text-fig.25).
Greatest length of fossil, 24 mm . (representing a complete wing about 25 mm . long, with a small piece of the extreme base missing); greatest breath, 8.2 mm .

This fossil is perfectly preserved, except for a small portion of the base and anal area; the wing had evidently been torn transversely across the anal veins before becoming fossilised, so that these veins are all slightly displaced basally. A weak, irregular curved line below the basal portion of $\mathrm{C}_{1}$ appears to represent the crinkle in the wing-membrane due to this displacement the first vein lying below this crinkle should be $\mathrm{Cu}_{2}$, the second 1 A , and the third $2 \mathrm{~A}, 3 \mathrm{~A}$ being apparently obliterated owing to the poor state of preservation of the wing near the base anally. It might be maintained, however, that these three veins were the three anals, $\mathrm{Cu}_{2}$ being represented either by one of the two oblique descending branches from $\mathrm{Cu}_{1}$, or possibly even by the weak, curved line which I have preferred to interpret as a crinkle in the membrane.


Text-tig.2.
Aristopsyche superha, n.g. et sp., forewing. Upper Trias of Ipswich, Q. C, distal end of short costal vein; rest of lettering as usual in Com-stock-Needham notation; $(\times 4)$.

Cross-veins present are :- two between the costal border and the short separate vein $C$; five between the costal border and Sc, of which the most basal is bent backwards towards the tip of

C; one in the pterostigmatic space; one between $\mathrm{H}_{1}$ and $\mathrm{R}_{2+3}$; one between $R_{3}$ and $R_{4}$, closing the radial cell distally; one from $\mathrm{R}_{4+5}$ to $\mathrm{M}_{1+2}$; one from $\mathrm{R}_{5}$ to $\mathrm{M}_{1}$; a short one connecting Rswith M , quite close to the origin of the former; one between $\mathrm{M}_{2}$ and $\mathrm{M}_{3}$, closing the median cell distally; one from near the origin of $\mathrm{H}_{4}$ to $\mathrm{Cu}_{1}$, with a second somewhat distarl from it: an oblique one (pussibly a brancl veinlet) from 1 A to $\mathrm{Cu}_{2}$ : and three between 1 A and 2 A . The two oblique veins running from $\mathrm{Cu}_{1}$ downwards are very strongly marked, and quite different from the other eross-veins; so that I have little duubt that they represent true branches of this vein.

Ty pe, Specimen No. 148a. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.
Genus Neuropsyche, n.g. (Text-fig.26).
Characters of forewing :-A moderate-sized wing with narrow costal area and very narrow, elongated radial cell; pterostigma very long, without any veinlets. Numerous veinlets in costal area, also a number of excess cross-veins scattered irregularly. Sc and $R$ very close together. First and second apical forks very narrow and close together; third and fourth broad and normally placed. $\mathrm{Cu}_{1}$ a straight vein without any branches in the preserved part; the same is true of $\mathrm{Cu}_{2}$ and 1 A . Both radial and median cells closed, the first, second, and fourth apical forks sessile, the third very definitely stalked.

Genotype, Neuropsyche elongata, n.sp. (Upper 'Iriassic, Ipswich, Q.).

Evidently elosely allied to Mesopsyche from the same horizon. It differs from the latter genus in lacking the subdivision of the second apical fork into three separate cells, but possesses instead two cross-reins in the first apical fork. In Mesopsyche the costal area is not crossed by numerous veinlets, nor is the third apical fork stalked, but arises exactly from the upper distal angle of the median cell. Mesopsyche also lacks the excess crossveins which are so conspicuous in the new genus.

Neuropsyche elongata, n.sp. ('Text-fig.26).
Greatest lough of fragment, 11 mm , representing a wing whose total length was about 16.5 mm . Greatest breadth, 4.8 mm .

The impression is a faint one, but can be made ont with very little difficulty in a good light. All the basal part of the wing, together with the extreme distal part, from the apex obliquely downwards to the distal ends of Cu and 1 A , is missing. In the short distal end of the costal area preserver, no less than four veinlets are visible; so that it is fairly certain that this area was well supplied with reinlets the whole way along. Below the apical end of Sc, two small cross-veins pass downwards to $R$; but the whole of the true pterostigma is smooth and free of veins.


Text-fig. 26 .
Neuropsyche clonyutce, sig. et sp., forewing. Upper Triads of Ipswich, Q; $(\times 8)$. Lettering as usual.

The pterostigmatic furrow is well marked, between $R_{1}$ and $R_{2}$. Other cross veins present are :-four between $R_{1}$ and $R$, of which the most basal passes on in a straight line to M ; two between $R_{3}$ and $K_{4}$, one closing the radial cell, the other slightly distad from it; one (not well preserved) between $\mathrm{R}_{4+5}$ and $\mathrm{M}_{1+2}$; one closing the median cell distally; two between M and $\mathrm{Cu}_{1}$; and two between $\mathrm{Cu}_{3}$ and $\mathrm{Cu}_{2}$.

Type, Specimen No. 228a. (Coll. Queensland Geological Survey).

Horizon: Tpper Triassie, $\mathrm{I}_{\mathrm{p}}$ swich, Q.
A stude of the four genera of Paratrichoptera now known from Ipswich makes it extremely questionable whether they can be regarded as lying in the direct ancestral line of the present Trichoptera. It is, of course, quite certain that recent Trichoptera must have been originally derived from Trichopterouslike insects in which the high specialisation of the anal veins, now present throughout the Order, had not been established. But all archaic recent Trichoptera have a very definite dichotomy of the first cubitus distally, forming the fifth apical fork; whereas it is quite evident that the Paratrichoptera did not possess this fork, but had instead a straight $\mathrm{Cu}_{1}$, of the type seen in all fossil and recent Mecoptera.

## Order PLANipennia.

## Family PROHEMEROBIIDA.

In No. 1 of this Series (3, p.178), I described from Ipswich the genus I'rotopsychopsis, placing it in the above family for reasons there given. Since then, I have received a very beautifully preserved fragment of a Prohemerobiid wing, showing most of the basal part of the wing, with all the most important veins preserved. This fossil appeared at first to be so exactly like the recent Meyapsychops illidyei that I began to think that the family Prohemerobiidere could no longer be maintained. However, a careful study of the new fossil shows certain important differences, which, taken in conjunction with our knowledge of the Liassic and Jurassic Prohemerobiide of Europe, and of the recent Psychopsidu, make it quite certain that the former family must be maintained; while it is now capable of definite proof that the latter family is a direct descendant therefrom. This proof will be furnished below, after the definition of the new genus, and the description of the fossil, have been given.

Genus Arcilepsyciops, n.g. (Text-fig.27).
Characters of preserved basal part of forewing as in the recent Mey"psyrhops, with the following differences:--Costal veinlets at extreme base arising at right angles to Sc , the recurrent vein
giving off anterior branches only (as in hindwing of Meyapsychops); further distad, the direction of these veinlets changes rapidly, until, at the most distally preserved part of the wing, they make an angle of only about $30^{\circ}$ with Sic. No costal series of cross-veins between the costal veinlets. The most basal branch of Rs $\left(=R_{4+5}\right)$ still preserves its dichotomous branching, and both $R_{4}$ and $R_{5}$ again branch dichotomonsly in the preserved part. 1A also dichotomously branched.

Genotype, Archepsychops triassica, n.sp. (Upper Triassic, Ipswich, Q.).

Arciepsychops trassica, n.sp. (Text-fig.27). G'ratest length of fragment, 6.7 mun.; greatest breadth, 6 mmm .


Text-fig.ET.
Archepsychops triassich, n.g. et sp., preserved portion of forewing. Upper Trias of Ipswich, Q. : of, primary rarlial fork: ff, secondary radial fork: rest of lettering as usual: $\left(\times 10 \frac{1}{2}\right)$.
(Measurements of the corresponding portions of the forewing of Meyapsychops illidyei are almost exactly the same size; so that
the fossil should represent a portion of a large wing of about the same size as that of M. illidyei, viz., about 27 mm . long). All the main veins and branches beantifully preserved, very strongly formed: the cross-veins, which are only present between Sc and $\mathrm{K}_{1}$, and between $\mathrm{R}_{1}$ and Rs , are weak and difticult to make out, but can be clearly seen in oblique evening sunlight. Sc, $\mathrm{R}_{1}$, Rs, and $\mathrm{Cu}_{1}$ are exceptionally strong veins, as also in M. illidyei. The direction of $\mathrm{C}_{1}$, which makes an angle of as much as $50^{\circ}$ with Rs, is quite exceptional, but is about the same as in the forewing of IV. illidgei; likewise the weak formation of $\mathrm{Cu}_{2}$, and its position parallel and very close up to $C u_{1}$, is similar in bot $h_{1}$. No less than ten brancles of Rs are present in the preserved portion of the wing; so that the total number of branches must have been very large, as also in $M$. illidgei. The formation of M is peculiar. Owing to the strength and thickness of $\mathrm{Cu}_{1}$, which stands on a high ridge, it is not easy to make out the exact formation of the much weaker concave vein M near its base. But, viewed with a good light in the right direction, there can be seen a weak posterior branch of $M$ arising from the main stem quite close to the base, and running between and parallel to M and $\mathrm{Cu}_{1}$, until it meets with an oblique eross-vein descending from M just before the first clear dichotomy; it then curves in to join $\mathrm{Cu}_{1}$ just below the dichotomy of M . Being in doubt as to the interpretation of this peculiar formation, I examined the forewing of $M$. illidyei, and there found, in the same position, a distinct but weak branch of $M$ arising in the same manner, and ending on a cross-rein descending from the first evident dichotomy of M, as shown in Text-fig.28, a. As this character appears to be of some importance, I also examined the forewing of Psychopsis elegans (Guér.), and was surprised to find a closely similar formation there. I think that there can be little doubt that this vein, which I unfortmately overlooked in my previous studies of the Psychopside, is really the posterior branch from the first dichotomy of I , and should therefore be called $\mathrm{I}_{5}$. It must evidently be the homologue of the vein called the posterior arculus by Comstock in the Trichoptera and Lepidoptera, and also visible in the Mecopteron Stereochorista described on p. 196
of this paper. Tt will follow from this that the primary median fork, like the primary radial and culital forks, lies close to the hase of the wing, and that the more distal fork, which has hitherto been regarded as the median fork, is really the secondary median fork, homologous with the secondary radial and cubital forks. Beyond the formation already described, only one dichotomy of $\mathrm{M}_{1-4}$ can be seen in the fossil; but there were almost certainly further dichotomies in the lost portion, judging by the somewhat diverging directions of the branches of $M$ and of $R_{i+5}$. (M has at least fon branches in M. illidyei, apart from the vein $\mathrm{M}_{5}$ already mentioned).

Type, specimen No. 137 a. (Coll. Qucensland Ceological Survey).

Horizon: Upper Triassic, Ipswich, Q.
Discussion of the Relutionship betueen the Fossil Prohemerobiida and the Recent Psychopsidie.
In Text-fig. 28, I show the bases of fore- and hindwings of Megapsychops illidyei (Eroggatt), the most archaic of existing Psychopsidre, for comparison with the fossil Archepsychops. It should be stated, at the start, that the venation of Megapsychops is absolutely mique, and that there is no other known insect, fossil or recent, which possesses the same characters, or anything closely approaching them. From the rest of the Psychopsitut it is widely separated by the large number and closeness of the branches of Rs, the four- to six-branched media, and the remarkable structure of the cubitus.

Comparing Text-figs.27-28, we see that the forewing of the fossil Archepsychops is intermediate between the fore- and hindwings of Megapsychops in the form of the costal veinlets-the immense breadth of the costal space resembling that of the forewing of this latter genus, while the type of branching of the recurrent costal reinlet is that found in the lindwiny only of Megapsychops. Apart from the absence of the costal series of cross veins, which never occurs in any Prohemerobiid, the principal difference between the forewings of Archepsychops and Meyapsychops is the great change in the direction of the costal
veinlets in the former, even in the short space of the wing preserved in the fossil. This character might be passed over as of little importance, were it not quite incompatible with the fundamental character of the family Psychepsider, viz., the broadly rounded apex, with wide costal area from hase to tip. Those Liassic and Jurassic Prohemerobiader which are best preserved


Text-fig. 28.
Megupyschops illirlyei (Froggatt). Basal thind of forewing ( $t$ ) and hindwing (h) for comparison with Text-fig. 27 ; $(\times 5)$,
show, for the most part, a costal area fairly broad at the base, but rapidly narrowing towards the apex, which is always much less rounded than that of the P'sychopside; concurrently with this more primitive shape, there is an entire absence of any formation of a vena triplica, the three veins $\mathrm{Sc}, \mathrm{R}_{1}$, and Rs remaining primitive in form from base to apex. Now, if we turn to the study of the wings of any Psychopsid, we see that the broad apex, together with the specialisation of the greater parts of $\mathrm{Se}, \mathrm{R}_{1}$, and Rs as a venue triplice, is correlated with a condition of the costal veinlets which is quite different from that found in the fossil. In the Psychopsidep, these veinlets, from near the base right up to near the end of the vena triplica, come
off at an angle exceeding $45^{\circ}$, and all are approximately parallel to one another. Thus, a little thought will show us that the condition of these veinlets shown in the fossil is definite proof that the wide costal area existing at the base does not continue further distad, and that the more distal portion is of the narrower Prohemerobiid type.

Further evidence in the same direction is afforded by the existence in the Ipswich Trias of the Prohemerobiid Protopsychopsis venosa Tillyard, deseribed by me in No. 1 of this series (3, p.178). This fossil is only represented by the apical portion of the wing, which is of true Prohemerobiid type, with narrow costal area. It is not possible, owing to obvious differences of size, that Protopsychopsis and Archepsyrhops represent apical and basal portions of the wing of the same species; but it is extremely probable that they are parts of the wings of two closely allied insects, and very unlikely that they represented two distinct families. Indeed, if we were to restore Archepsychops on the supposition that its apical portion resembled that of Protopsychopsis, we should obtain a Prohemerobiid wing in its entirety, and there would be no clashing of characters anywhere.

Turning now to the relationship of Archepsychops to the recent Megapsychops, we see at once that there is not a single character present in the former which is incompatible with its being considered as the direct ancestor of the latter. When we consider how unique Megapsychops is in its venation, we must see that this is a very remarkable thing. If we add to this, that the differences in size of the two insects, and in the strength and closeness of their veins, are practically negligible, and that Megapsychops at the present day is only known to inhabit an isolated mometain-top situated some thirty miles from the Ipswich Fossil Beds, we see how strong a case there is for considering the fossil Archrpsychops to be the direct ancestor of the recent Meyapsychops. If this be accepted, then it has aiso been demonstrated that the Psychopside, as a family, are the direct descendants of the older P'rohemerobiact; the changes required to evolve the one from the other, through the immense period of geological time beginning with the Upper Trias, being really
only a change in the shape of the wing, with its consequent alteration in the size and direction of the costal veinlets, and with a correlated specialisation in three parallel main veins, to form the rena triplica (as a kind of backhone or rachis for the widened wing), and a further strengthening of the veinlets by formation of the costal series of cross-veins.

There is one other point of interest in the renation of Archepsychops. Comstock, in a recent work(1), has elaborated the theory of the origin of the Planipenmia from an older stock with dichotomously branching wing-veins, such as we find in the Mecoptera and Trichoptera. The condition of $\mathbf{R}_{4+5}$ in the new fossil is direct evidence in favour of this, hat not in favour of the restriction of the number of dichotomous branches of hoth Rs and M to four, which Comstock also holds. For it is quite clear that both $R_{4}$ and $R_{5}$, in this fossil, are again dichotomonsly branched not far from their origins; and quite possibly they may be even branched again, further distad. Thus, we should conceive of the ancestral form as having, indeed, truly dichotomous] branching sectors of Rs and M , but withont any unnecessary limitation of the number of those dichotomies. Such a type is to be seen in the Protomecoptera, also from the Ipswich Trias, in which the number of branches of his is very large, but all are elearly primitive dichotomies. If we could find the type that gave rise to both Archipunorpu and Archepsychops, we should most probably have discovered the ancestor of the whole of the Panorpoid Orders.

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Note on Archipanorpa mennifica (Order I'rotomecoptera):- In No. 1 of this series(3), I gave two drawings of the archedictyon or primitive meshwork of the wings of this fine fossil, one in Text-fig.6, the other on Pl. viii., fig.6. I now desire to draw attention to the fact that 1 have succeeded in making photo. micrographs of this structure, and that they have recently been published in Part 2 of "The Panorpoid Complex" (These Proceedings, 1918, xliii., Part 3, Pl. lxvii.). These photographs give a much more accurate idea of the true appearance of the archedictyon, the previous drawings having been diagrammatic, and, therefore, possibly somewhat misleading as regards the detailed structure of the meshwork.


[^0]:    (1)
    $\left\{\begin{array}{l}\text { A short costal vein present, separate from the costal margin; } \\ \text { all four apical forks free of cross-veins ........ Amsstorsiche, n.g. } \\ \text { No separate costal vein (or basal part of costa nut preserved); } \\ \text { at least one apical fork with definite cross-veins ........... } 2 .\end{array}\right.$

